Edinburgh Imaging
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Common Image Processing Techniques 2

Semester 2 / January **10 Credits**

Each Course is composed of Modules & Activities.

Modules:

Retinal Image Analysis	NI4R	IMSc	
Introducing tractography	NI4R	IMSc	NRGN
Registration Techniques	NI4R	IMSc	
Voxel Based Analysis	NI4R	IMSc	
Image segmentation thresholding	NI4R	IMSc	
DWI Basic Quantification	NI4R	IMSc	NRGN
Perfusion Imaging	NI4R	IMSc	

Each Module is composed of Lectures, Reading Lists, MCQ self-assessments, & Discussion Boards.

These Modules are taught on the following Programmes, or are incorporated into blended Courses which teach students enrolled outwith the Edinburgh Imaging Academy:

- NI4R - Neuroimaging for Research programme
- IMSc - Imaging programme
- NRGN - Neuroimaging Research for Graduate Neuroscientists - course for MSc Integrative Neurosciences

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Modules:

Retinal Image Analysis:
Retinal Image Analysis

Introducing tractography:
Introducing tractography

Registration Techniques:
Registration Techniques

Voxel Based Analysis:
Voxel based analysis

Image segmentation thresholding:
Basics on thresholding-based image segmentation techniques

DWI Basic Quantification:
DWI Basic Quantification – Lecture 1
DWI Basic Quantification – Lecture 2
DWI Basic Quantification – Lecture 3

Perfusion Imaging:
Basics
Advanced

We can also provide a more detailed syllabus showing what lectures will be given for each module, and the learning outcomes for each module.

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Retinal Image Analysis

Lecture 1
Title: Retinal Image Analysis
Description: Measurement of retinal features following the application of image processing techniques
Author(s): Dr. Tom MacGillivray
Learning Objectives

- Describe the generation of a retinal photograph
- Outline various methods of image processing relevant to brain imaging including:
    - the use of shape information (morphology) to construct shape-sensitive filters
    - the use of image filtering to improve edge recognition for improved segmentation of images
- Cite examples of these techniques applied to measure features in an image

Introducing tractography

Lecture 1
Title: Introducing tractography
Description: The role of tractography in brain imaging
Author(s): Mr. Jonathan Clayden
Learning Objectives

- To show how information on the direction and integrity of white matter tracts in the brain can be obtained using diffusion MRI
- To give an overview of the current approaches to white matter fibre tracking and their relative merits

Registration Techniques

Lecture 1
Title: Registration Techniques
Description: Understanding the what and how of registering images
Author(s): Mr. James Withers
Editor(s): Dr. Andrew Farrall
Learning Objectives

- Explain what is meant by multi-modal MR
- Define registration and segmentation
- Discuss some problems with registration and their solutions

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Voxel Based Analysis

Lecture 1
Title: Voxel based analysis
Description: Voxel based analysis means and methods used to research the dependence of psychosis symptoms on structural MRI
Author(s): Dr. Bill Moorhead
Learning Objectives

- Describe the application of voxel-wise analyses for cross-sectional analyses and longitudinal analyses
- Outline the usage hand tracing methods to implement Region of Interest (ROI) Analyses
- Explain the development of automated parcellation techniques that allow protocols to be applied to large cohorts
- Describe the implementation of AutomatedGyrification Index A-GI a technique that measures the folding characteristics in brains
- Outline benefits and limitations of these approaches

Image segmentation thresholding

Lecture 1
Title: Basics on thresholding-based image segmentation techniques
Description: Principles of thresholding and its application in medical image processing are explained and some examples are analysed
Author(s): Dr Maria C. Valdés Hernández
Learning Objectives

- Explain what thresholding is and discuss some of its applications in medical imaging
- Explain what the advantages and limitations of thresholding are in medical imaging processing
- Discuss the characteristics of different thresholding techniques and mention some of their applications in medical imaging

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DWI Basic Quantification

Lecture 1
Title: DWI Basic Quantification - Lecture 1
Description: The basic parameters that can be extracted from the diffusion scan, methods of extraction and clinical applications
Author(s): Dr. Susana Muñoz Maniega
Learning Objectives
- Define diffusion and explain principles behind it
- Outline the usefulness of the information is extracted from the diffusion image
- Describe ways of displaying the diffusion information
- Recognise actual equations used to calculate mean diffusivity and fractional anisotropy
- Recognise typical normal values in different brain tissues

Lecture 2
Title: DWI Basic Quantification - Lecture 2
Description: The basic parameters that can be extracted from the diffusion scan, methods of extraction and clinical applications
Author(s): Dr. Susana Muñoz Maniega
Learning Objectives
- List a few factors which affect reproducibility of extracted diffusion parameters
- Describe the changes in diffusion parameters in different brain tissues seen in a common disorder like stroke or schizophrenia

Lecture 3
Title: Diffusion MRI processing – Lecture 3
Description: The basic parameters that can be extracted from the diffusion scan, methods of extraction and clinical applications
Author(s): Dr. Susana Muñoz Maniega
Learning Objectives
- Outline how diffusion parameters might change with time after onset of disease
- List time-related factors which affect reproducibility of extracted diffusion parameters
- Discuss the effect that time related factors might have on interpretation of diffusion data from different brain tissues in a common disorder like stroke or schizophrenia

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Perfusion Imaging

Lecture 1
Title: Basics
Description: Basic principles of MR perfusion imaging
Author(s): Dr. Trevor Carpenter
Learning Objectives

- Define the Central Volume Principle (CVP)
- Describe Contrast Bolus tracking
- Outline the principles of how MR signal is converted to concentration
- List the relative perfusion measures and how they are obtained
- Distinguish between:
- Cerebral Blood Volume (CBV) and relative CBV
- Mean Transit Time (MMT) and relative MTT
- Cerebral Blood Flow (CBF) and relative CBF
- Name some applications of perfusion imaging and outline its role in studying disease

Lecture 2
Title: Advanced
Description: Advanced principles of MR perfusion imaging
Author(s): Dr. Trevor Carpenter
Learning Objectives

- Understand the how the CVP is related to the residue function
- State the process the residue function describes
- Describe the difference between quantitative and relative measures
- Explain a basic approach to quantification
- State the assumptions this approach makes